The use of standards for identifying, codifying and transmitting expert ergonomic knowledge.

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Abstract. Formal technical standards based on ergonomic principles can ensure that products, systems and services are fit for purpose, accessible and useable. The application of these standards should be used to ensure that items of technology meet political requirements for equality by enabling the full range of end users to participate in the digital society. Ergonomists and representatives of consumers participate in the specification and creation of these standards to ensure that their content is relevant, correct and up-to-date. They work to ensure that the standards accurately represent the needs and requirements of end users including amongst others people with disabilities, older people and people with different language and cultural backgrounds. A number of these standards are referenced in law and in procurement contracts. They are not often not used in higher education resulting in knowledge deficit for young technical professionals. The paper is based on the authors experience including working in the area of accessibility standardization and at a University which prides itself on the diversity of its staff and has students from more than 150 nations. The paper ends with a consideration of the way in which more effective use can be made of these standards.

Keywords: Standard, Knowledge Transfer, Accessibility.

1 Introduction

Formal international standards are used by ergonomists as methods of identifying, codifying and transmitting their expert knowledge. This knowledge has the potential to ensure that systems, products and environments can fully meet the needs of all consumers. This can be of particular benefit when considering the needs of older and disabled users as their needs and requirements may not be appreciated by designers and specifiers. Population changes including the ageing of the population and the widening of the use of digital systems for everyday tasks mean that systems, products and environments need to meet the needs of the widest possible range of people. This has in turn increased the need for easily available design guidance to be available to designers and operators of digital systems across the world.

"Formal standard documents provide established and approved knowledge on the state of the art of technology", this act of codifying knowledge can be used to meet the political and policy requirements for equality of opportunity [1] by enabling equal ac-

cess to the systems necessary for work, study and daily living. By basing these standards on high quality ergonomic principles usability and accessibility can be ensured for end users with different physical, cognitive and cultural abilities and backgrounds. In particular Design for All standards can be used to apply ergonomic principles, methods and tools to enable design which facilitates universal access. It can therefore be seen that "standardization activities and the continuous tracking of standards information should be tied to the new product development process" [2].

2 Enabling Accessibility and Usability

Standards in the area of Human Computer Interaction are essential tools to enable the creation of the digital systems that are essential to modern life that are useable and accessible by as many people as possible. The standards in this area have become essential tools to enable the requirements of public equality legislation to be meet. "Although legislation, rules and demands do not directly guarantee the proper implementation of accessibility standards, they do have a positive influence on the process"[3].

2.1 EN 301 549 "Accessibility requirements suitable for public procurement of ICT products and services in Europe"

The creation of standard EN 301 549 demonstrates the synergy between political ambition for equality of access to digital technology and the use of standards to enable that equality by the provision of relevant ergonomic and technical information.

EN 301 549 'Accessibility requirements suitable for public procurement of ICT products and services in Europe', was produced by CEN, CENELEC and ETSI in response to a request from the European Commission (Mandate 376). The mandate was originally issued in 2005 and the standard issued in 2014. EN 301 549 may be referenced in policy or legislation by any supranational, national or regional authority wishing to incorporate internationally harmonized technical specifications on the accessibility of ICT. This version of the standard was created by a wide range of experts including representatives from industry, consumers, people with disabilities and older people. There was extensive interest in the creation of this standard from user representatives.

In 2017 a new mandate was issued to call for EN 301 549 to be revised to ensure the digital accessibility standards were applicable for public sector websites and mobile apps [4].

The principles and practice of ergonomics have proved to be an essential grounding of the scope, the content and the ways of working in the creation of this harmonized standard. In particular they have enabled the authors and members of the steering committee to focus on both the timeframe for the work and the usability of the final document.

3 Role of Standards

`A standard is a collective work. Representatives of organizations having an interest and expertise in the subject matter are brought together….' [5] Formal technical standards offer a variety of useful knowledge collection and knowledge sharing roles as described below:

3.1 Codifying Knowledge

Formal technical standards are a way of codifying knowledge which can then be passed on and used by both experts and new users in a particular field. Different types of standards exist for different purposes, these include [6]:

- Specifications set out detailed absolute requirements.
- Codes of practice recommend sound good practice.
- Methods set out an agreed way of measuring, testing or specifying.
- A Vocabulary is a set of terms and definitions.
- Guides are published to give less prescriptive advice.

Accessibility and usability knowledge can be codified into all type of the standards listed above. The use of ergonomic information in standards is one successful way in which ergonomic knowledge can be used to influence the design process. [7]

3.2 Maintaining Relevance

Formal technical standards follow a regular cycle to ensure that their content is both relevant and required. The stages of the creation of an International Organization for Standardization (ISO) standard are as follows [8]:

- Proposal Stage, to identify the need for the standard and the parent committee in charge.
- Preparatory stage, to identify suitable experts for a working group and to investigate issues around copyright, patents and conformity assessment.
- Committee stage, if required this stage is used to acquire information from the experts on the parent committee.
- Enquiry stage, to enable all ISO members to vote on the standard.
- Approval stage, if required this stage is used to deal with any proposed changes.
- Publication stage, the standard is published.

These stages are then repeated at regular intervals when new knowledge is used to re-write the standard and to ensure that the content is still relevant.

3.3 Knowledge Transfer

The main role of standards is to share knowledge and to enable best practice to be followed in the design of products, systems and services, `In a constantly evolving field, understanding each other can be tricky…. this makes it very difficult ….. to understand,

plan, budget, enact policy, or conform to accessibility requirements and legislation [9]. The creation of standards involves the translation of research and data into usable methods and information for practitioners [10]. This sharing of knowledge is particularly important for those professionals who may be working at the borders of their knowledge of for new professionals to build their skills and knowledge base.

3.4 Supporting Creativity

Standards are used to provide basic building blocks of knowledge to enable innovation to take place. `Interface standards allow innovative solutions from different suppliers to work together…thereby encouraging new products, services and processes' [11]. The use of standards can also assist in the management of innovation by enabling the knowledge base to be defined and shared before the research begins [12]. The use of standards therefore enables prior knowledge to be both expanded and communicated.

3.5 Legal Reference Document

International Standards can be referenced in legislation [13], this is of particular relevance in the ergonomic field when the Web Accessibility Initiative (WAI) Web Content Accessibility Guidelines (WCAG) version 2.0 were approved as an ISO standard: ISO/IEC 40500:2012 thus facilitating their use in legislation to improve web site accessibility.

3.6 Contractual Reference Document

Standards can be used in contract law to ensure the quality of the product and by building confidence among consumers. A wide range of standards are used in the specification of digital systems and the design process of creating them. In particular EN 301 549 (see above) has been designed for its role in public procurement.

3.7 Education of Students

Standards are potentially a good source of design information for students, in addition a significant proportion of standardisers are employed as academics. The expertise that the academics exhibit whilst working on standard committees comes from a history of working in a relevant area. This underlying expertise and useful codification and transmission of information via standards is often undervalued as standards are not seen the have the same academic impact as academic papers. In the UK for instance the writing of standards will not be considered highly important during the REF (Research Excellence Framework)) assessment exercise for academics [14].

3.8 Knowledge Sharing (Team Building)

The experts involved in the creation of the standards contribute information to the standardization process and also gain knowledge from their fellow experts, thus in-

creasing their expertise. These communities serve to structure the knowledge ` communities … also the best places to organize, codify, and transform … knowledge' [15]. The quality of the standard created depends on both the skills and expertise of the members and the range of their experience, the participation of a wide range of stakeholders is important to improve the quality of standards and legitimize the outcome of the standardization process [16]. The members of the community involved in the creation of EN 301 549 are all active in the accessibility area and have carried out a range of activities in support of the standard and its use.

4 Conclusion

The different people involved in standardization can work together to ensure that high quality systems, products and environments are created and promoted. They do this by using the formal standardization process as a tool for codifying verifying, updating and communicating best practice design and specification information. This offers considerable potential benefits to the end user of digital systems by enabling them to participate in fully in the digital environment when the systems they use for access are designed following high quality ergonomic and accessibility standards.

Standards are evolving documents and as such no standard is perfect but the planned and updating and possible obsolescence of standards does assist in ensuring the quality of these standards.

Standards writing is an important example of demonstrating professional skills for those involved in the process. It is hoped that in the future a greater number of professionals including academics will come together to write standards. This would also to a small extent meet the requirements of the European Commission Joint Initiative on Standardization which calls for European Academic Institutions to share their expertise [17].

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